From: pnt-eo@list.nist.gov on behalf of Keith Peshak <keith.peshak@gmail.com>
Sent: Friday, June 5, 2020 12:40 PM
To: pnt-eo@list.nist.gov
Subject: [pnt-eo] Second PNT

I will start with evidence provided by the FAA proving that GPS does not even have two 9s of availability and reliability:

https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fsapttest.faa.gov%2Fraim-summaries.php%3FoutageType%3D129001450&data=02%7C01%7Cthelma.allen%40nist.gov%7Cf5b7e74b18e14c2f2b6208d8096f1ac4%7C2ab5d82fd8fa4797a93e054655c61dec%7C1%7C0%7C637269720089813979&sdata=1EqVSxA6OzSsSTYNQJQPhANJJXCkx17q3DuVEX%2F4%2Bbc%3D&reserved=0

PNT for aircraft is all about positioning and navigation, where am I and where is the runway, because I am extremely low on fuel (it is uneconomical to carry extra weight) and I am IMC (in meteorological conditions and cannot see one foot in front of me all of the way to hitting the (hopefully) runway). We had developed CatIIIc eLoran, using pressure altitude altimetry (GPS aircraft installations use that because it is more accurate than GPS altitude) just like the pilot altimeter. Localizer and Glideslope and DME to land on the runway threshold, pointed down the runway, hands off, every runway including your back yard grass strip. eLoran was installed over the continental US, cost $12M to operate annually, and was working doing that, when it was abruptly shut off, ostensibly to save $12M/year. It could not be jammed by a bad actor. It could not be spoofed by a bad actor. With the H field aircraft antenna, it was not bothered or confused by thunderstorm weather. With a multichain receiver it had more 9s than you would ever need. Management summary: better than GPS (our only PNT) in all parameters.

The dozen or so transmitter sites in the continental US are still there, abandoned. The buildings and equipment will need work because of looting. Wild Goose (International Loran Association) can be reconstituted. The vender that built and installed the eLoran equipment is still around (equipment lost can be duplicated). Use the data channel to send electronic ASF additional secondary factor map, like the WAAS "channel" is used to correct GPS propagation anomaly.

If you want to know how we did CatIIIc to anywhere you want to better than GPS performance, my how to paper is in the ILA library. We also used this during the Viet Nam war for precision bombing. Just because it is old does not mean it is not the best that there is. You can do this again, just turn the transmitters back on.

https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.loran.org%2F&data=02%7C01%7Cthelma.allen%40nist.gov%7Cf5b7e74b18e14c2f2b6208d8096f1ac4%7C2ab5d82fd8fa4797a93e054655c61dec%7C1%7C0%7C637269720089813979&sdata=6wRcEPoDUJ9zP1tKo5sjhCkYsxX%2FZJql8Ul%2FoCMHOU8%3D&reserved=0

Let's flesh this out some more, to avoid having to read my ILA paper.

The e in eLoranC is for the added pulse in the pulse chain transmission of the LoranC signal from the master station of the chain. The older LoranC receivers would just ignore this added pulse, so they continue to be LoranC receivers like they did before. You can liken this to when two more "color" modulations were added to TV signals later in NTSC, and all of the black and white TV receivers still worked like they did before.

LoranC, because of the ASF which does not change with weather, changes with ground deposits conductivity, has poor absolute accuracy (take me to the Lat Lon that the FAA published for the runway threshold). The old expression "missed by a mile", not good in IMC. In fact, just not really too useful used that way.

LoranC, because of the ASF which does not change with weather, changes with ground deposits conductivity, has great repeatable accuracy (take me back to what I memorized when I was here before, I don't care what Lat Lon that the FAA published for the runway threshold). The old expression "within a few hundred feet", just fine in CatI IMC. In fact, good enough for the majority of landings in most IMC, just not good enough for autoland.

We could put an ASF electronic map in non-volatile memory in the LoranC receiver, maybe even ROM memory. But that isn't good enough.

LoranC, because of the ASF which does change with seasonal weather shift and unusual severe rain events, gets degraded with repeatable accuracy. The old expression "crashed because of monsoon season", not good when the ground moisture changed significantly. In fact, just not really too useful.

Why they called it old and obsolete. But they weren't listening.

eLoran pulse position modulated that last new pulse, for the new eLoranC receivers that where designed to listen to it. That provided a very slow baud rate digital data message. Now, we started arguing about what that data message should be used for.

The politically adroit (won the debate) voted for a WAAS correction signal for GPS propagation anomalies. The coast guard had already done that on their non-directional beacon transmitters (LAAS), made GPS real absolute accuracy precise near the beacon, beat GPS WAAS absolute accuracy. They sought to keep Loran alive along with GPS. Notable goal, wrong thing to do, didn't work to keep Loran alive.

We should have developed an ASF broadcast, that would correct timely weather changes to the eLoranC absolute accuracy based on monitor station input (I know where I am, this is where I calculated I am, use this error difference when you calculate where you are).

That is a single point (LAAS type) analysis example, would only work near the monitoring station. So we need to develop a large area grid (WAAS type) correction map. And update it periodically based on input from a grid of monitoring stations.

We no longer would need to rely on Loran repeatable accuracy, could beat FAA GPS WAAS in accuracy, expect it would beat coast guard GPS LAAS.

That is how I did 2D CatIIIc (where we used atmospheric pressure altimetry with a digital ATIS broadcast at the airport for vertical accuracy to within about 10'). Good enough for general aviation (they don't bounce too high when you try to land 10' below the pavement, don't bend up when you stall 10' above the pavement). Augment with radar altimetry when within 50', if you can afford that. Pillow soft heavy iron landing every time.

Now all you have to worry about is crosswind. Everything else is precise, jam proof, spoof proof, lightning noise proof, multichain reliability enhancement and geometry issue mitigation.

And we have a backup PNT that is automated and cheap to operate (at about $12M per year (that's with an M, not a B)).

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all others not checked often

Large files and attachments send to keith.peshak@gmail.com

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